

WATERFOWL BREEDING POPULATION SURVEY FOR WISCONSIN, 1973-2006



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TABLE OF CONTENTS

SURVEY INFORMATION	1
ABSTRACT	2
INTRODUCTION and METHODS	3
RESULTS AND DISCUSSION	5
Survey Timing	5
Precipitation	6
Wetlands	6
Mallards	7
Blue-winged Teal	7
Wood Ducks	7
Other Ducks	7
Total Ducks	8
Canada Geese	8
LITERATURE CITED	10
<i><u>Tables and Figures</u></i>	
Wisconsin Precipitation (Table 1)	11
Wetlands Per Square Mile, 1973-2006 (Table 2)	12
Breeding Waterfowl Population Estimates, 1973-2006 (Table 3)	16
2006 Breeding Waterfowl Data (Table 4)	21
Transect Lines and Regions Surveyed (Figure 1)	23
Climatology Divisions (Figure 2)	24
Mallard Population Estimates (Figure 3)	25
Blue-winged Teal Population Estimates (Figure 4)	26
Wood Duck Populations Estimates (Figure 5)	27
Total Breeding Duck Population Estimates (Figure 6)	28
Canada Goose Population Estimates (Figure 7)	29

TITLE: WATERFOWL BREEDING POPULATION SURVEY FOR WISCONSIN, 1973-2006.

STRATA SURVEYED: Southeast Central (SEC), Northern High Density (NHI), Northern Low Density (NLO) and Southwest Driftless (SWD).

DATES: May 1 - May 17, 2006.

Air Survey: Completed in 12 days, spanning 16 days: May 1-5, 8-12, 15-16.

Ground Survey: 12 days, spanning 16 days: May 2-6, 9-13, 16-17.

DATA SUPPLIED BY: Wisconsin Department of Natural Resources (WDNR), Great Lakes Indian Fish and Wildlife Commission (GLIFWC), U.S. Department of Agriculture (USDA), U.S. Fish and Wildlife Service (USFWS), and Wisconsin Waterfowl Association (WWA).

AERIAL CREWS:

North: Pilot - Larry Waskow
Observers – Chris Cold and Pat Beringer

South: Pilot - Larry Waskow
Observers – Carrie Milestone, Paul Samerdyke and Brian Glenzinski

GROUND CREWS:

WDNR - T. Bahti, K. Benton, J. Carstens, J. Curry, G. Dunsmoor, B. Folley, G. Gray, H. Halverson, B. Hill, J. Huff, D. Matheys, R. McDonough, K. Morgan, W. Oehmichen, J. Robaidek, E. Williams, M. Windsor, D. Wyman,

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ABSTRACT: The 2006 Waterfowl Breeding Population Survey for Wisconsin was conducted May

1-17, following methods of the North American waterfowl population survey. The information from the survey is used as part of the overall survey of breeding waterfowl in North America as well as being important information in making state level waterfowl management decisions. This year was the 34th consecutive year we have conducted the survey. These data on Wisconsin waterfowl breeding populations are best interpreted as population trends viewed over several years rather than as year to year changes in the condition of waterfowl in Wisconsin. Spring precipitation was above average for much of the state and wetland conditions were generally fair to good when breeding ducks arrived in Wisconsin. Wetland conditions across the state were mostly above 2005 levels but still below the long term average in many areas suggesting average wetland conditions. Heavy rains during the survey period and shortly after the survey should have improved brood habitat in many areas. The total state breeding duck population estimate of 522,571 is down 28% from 2005 and 22% above the long-term mean. This estimate represents generally average numbers of breeding ducks when compared to the mean total breeding duck population estimate over the last 10 years (565,585). Last year's (2005) total state breeding duck population estimate was biased high because it included a high proportion of blue-winged teal in migration. The 2006 total mallard population estimate of 219,494 is 31% decrease over 2005 and 22% above the long-term mean (33 years). After 2 years of the spring breeding survey being conducted while significant blue-winged teal migration was occurring through the state, the 2006 survey appeared to occur after the teal migration. As a result, the 2006 blue-winged teal breeding population estimate of 108,701 is a substantial decrease from 2004 and 2005 but better represents the number of resident breeding blue-winged teal. The 2006 estimate is down 44% from 2005 and is 4% below the long-term mean (33 year). In 2006, the population estimate for wood ducks is 121,650 which is 14% below 2005 and 70% above the long-term mean. The statewide breeding Canada goose population estimate of 134,683 is up 9% from 2005 and 83% above the long-term (20-year) mean. Overall, spring breeding waterfowl numbers in Wisconsin for 2006 appear to be similar to recent years and represent a relatively stable and healthy waterfowl population.

INTRODUCTION: Decisions regarding hunting season structure and harvest limits in waterfowl management have a long history of being based in part upon spring breeding pair surveys. The US Fish and Wildlife Service's (USFWS) Waterfowl Breeding Population and Habitat Survey has been conducted for 51 years across the traditional survey area of north-central United States, Canada and Alaska. The WI Waterfowl Breeding Population Survey which modeled after the continental survey has been conducted for 34 years and provides a long-term measure of waterfowl breeding trends in WI. These data are used at the national and state level for monitoring waterfowl populations and making management decisions. Wisconsin's breeding waterfowl survey data are included in the Waterfowl Population Status Report published annually by the USFWS on continental waterfowl populations. In addition, mallard data from WI, MN, and MI are combined with data from the traditional survey areas as a basis for the Adaptive Harvest Management Report that is used to establish federal waterfowl season frameworks. At the state level, waterfowl breeding survey data are used to establish annual hunting seasons, to identify long term changes in species populations and to evaluate the impact of habitat changes and management. This report provides a summary and analysis of the 2006 survey data in support of these efforts.

METHODS: The breeding waterfowl survey in Wisconsin is a stratified double sampling scheme patterned after the North American waterfowl breeding population survey developed by the USFWS (Anon. 1977), but modified for local conditions (March *et al.* 1973). Fifty-five east-west aerial transects, each 30 miles long and 1/4 mile wide, were randomly selected in 1973 within 3 strata of Wisconsin: SEC, NHI, and NLO, based on duck densities and habitat (Figure 1). These strata total 43,359 square miles. In 1997, we added eleven aerial transects within the unglaciated SWD stratum (12,311 square miles) and included this stratum in our statewide population estimates. This area was not surveyed prior to 1997 because of its low wetland density.

The 2006 aerial survey was conducted in 12 days between May 1-16 using a Cessna 182 aircraft, flying 80-85 mph at a maximum altitude of 200 feet. An observer recorded waterfowl data from each side of the plane, with the observer on the north side of the plane recording the number and type of wetland basins within the transect. Visibility correction factors (R) for waterfowl not seen by the aerial crew were determined by counting waterfowl from the ground on segments (10-15 miles long) of 26

transects. The aerial surveys are generally initiated in the southern part of Wisconsin and crews progress to the northern transects. The ground surveys were done on 12 days that spanned May 2-17. Ground counts all done 0-2 days after the air count except one transect (#39) done 3 days after.. Over 30 people from 3 agencies and one NGO were involved in the planning and implementation of the survey.

A workshop for survey participants was held prior to the 2005 survey in order to improve survey consistency and operations. Several improvements were implemented that helped with crew communication and planning. Edits to the survey forms included:

- Adding a “Canada goose” column, along side columns for Mallard, Blue-winged Teal and Wood Duck
- Adding a place to record weather information on ground data sheets

Edits to the written instructions included:

- Emphasis that swans, cranes and coots need to be counted
- Emphasis on recording the number of birds in the flock or group under the FD and GR categories, not the number of flocks/groups
- Emphasis on surveying the fields in between wetlands (within the segment), not just the wetlands.

Survey results separate mallards, blue-winged teal, wood ducks, and Canada geese. All other ducks are pooled into a category of “other ducks”. In 2004, wood duck populations had increased to the point where we were able to estimate them as a separate group rather than as part of "Other Ducks". This is significant because we can now provide independent breeding population estimates for the 3 duck species that constitute the majority of Wisconsin’s fall harvest. R was calculated separately for each stratum-species group, but when the coefficient of variation (CV) of R exceeded 20%, the estimate of R was considered unreliable and the data for R were pooled for all strata (Bartelt and Gatti 1987). When the CV of R still exceeded 20% for the pooled strata, data from prior years were iteratively added until the CV of R was below 20%.

This survey was not originally designed for surveying Wisconsin's resident Canada goose population. If a survey was specifically designed for breeding Canada geese in Wisconsin it would be conducted earlier in the spring because of the earlier nesting chronology of Canada geese versus ducks in Wisconsin. Canada goose counts and population estimates were not included in this report prior to

1986 because of the small sample size. However, aerial counts of geese have increased steadily since the mid-1980s, making population estimates useful indices to population trends of breeding Canada geese. Reports by WDNR field personnel also indicate an increasing breeding Canada goose population in Wisconsin over this time period.

The survey was designed to detect a 20% change in total ducks observed. The population estimates of individual species groups have wider confidence intervals because of lower sample sizes and added variability of R. Population estimates for waterfowl species in individual strata should be treated with caution due to low sample sizes. Population estimates are most valuable when viewed over several years as an indicator of population trends rather than viewing them as exact measures of population on a year to year basis. Lesser scaup and bufflehead are not included in the state duck population estimates because they rarely breed in Wisconsin.

The determination of wetland type from the air is difficult to standardize when observers change over the years. Pooling data into linear (streams and ditches) and nonlinear (types I-VIII) wetland groups resolves some of the typing problems. The same aerial observers are used for 5-year periods to minimize problems with observer bias. In 2006, there were 3 aerial observers for the southern part of the survey, instead of 2. The third observer had been a part of the aerial crew in the past and was asked to fill in during another observer's absence.

RESULTS AND DISCUSSION:

Survey Timing/Weather: The timing of the breeding waterfowl survey is always a challenge because variables such as weather, bird species phenology, and leaf-out of trees all impact the timing, visibility, and accuracy of the survey. In 2006 the spring phenology cycle was early and poor weather conditions during the survey period resulted in a delay of 4 days past the planned completion of the survey. In particular, the second week of the survey period experienced heavy rain, high winds, unseasonably cold temperatures and even snow in some areas. Early nest attempts may have been negatively impacted. Dabbler migration through the state was advanced, incubation had begun in some areas and leaf out was also well along. This has positive and negative impacts on the survey data. Fewer groups (>4 ducks) in the survey indicates that we are counting more resident breeders rather than migrants but advanced leaf out and conducting the survey later in the breeding phenology can reduce the number of pairs observed. There were an overall lower number of groups observed

compared to previous years. Groups made up only 3% of the blue-winged teal, 6% of the Mallards, 8% the Wood Ducks, 9% of the Canada Geese, and 32% of other ducks observed during the survey. The number of “other ducks” in groups is typical for this survey and is a result of the influence of the later migrating diving duck groups in this category. No flocks of over 20 ducks were observed and only 3 flocks over 10 were seen.

Precipitation: Fall and winter precipitation was above average across the northern part of Wisconsin, about average to slightly below average in the central and southeast parts of the state, and below average in the west central and southwest parts of the state. (Figure 1; Table 1). Spring showed a different pattern as most of the state was above average for precipitation for the months of March through May. The northwest corner of the state was the only section that was below average during this time. Conditions were average to wet for much of Wisconsin during April and early May as waterfowl were arriving and making nesting decisions. Following early May when the breeding waterfowl survey was conducted, precipitation remained average to above average in many parts of the state.

Wetlands: Overall wetland numbers were up from the dry spring of 2005 but were still below the long term means in some areas and types (Table 2). Wetland numbers were higher in 3 out of 4 survey regions as compared to 2005 with the Southwest Driftless area being the driest. During and following the survey period, however, significant rainfall events would have increased or sustained seasonal and temporary wetlands (Types I-III). Total non-linear basins were: up 24% from 2005 in the SEC and 13% below the long-term (33-year) mean, up 35% in the NHI from 2005 and 10% below the long-term mean, up 58% in the NLO from 2005 and 25% above the long term mean. In the SWD, which has less suitable waterfowl breeding habitat, nonlinear basins were down 7% from 2005 and 11% below the 9 year mean. Total linear basins (streams and ditches) were: up 2% from 2005 in the SEC and 4% below the long-term mean, up 36% from 2005 in the NHI and 25% above the long-term mean, up 17% from 2005 in the NLO and 26% above the long-term mean, and down 15% from 2005 in the SWD, and 11% below the 9 year mean. Overall, brood habitat is expected to be good in 2006.

Mallards: The 2006 total mallard population estimate is 219,494 (+/- 30,548). This estimate is a 31% decrease over 2005 ($Z=1.85$, $P=0.06$) and 22% above the long-term mean (33 years) (Tables 3 and 4; Figure 3). This population estimate is similar to or slightly below recent years (1997-2006) which

averaged about 265,000. The overall trend on breeding mallards appears to be a leveling off of the population following a 20+ year increasing trend. As in previous years, the SEC represents the largest portion of the breeding mallard population (53%) which is consistent with the long term average proportion of the statewide mallard population (49%) for this region (Table 4, Figure 1). Because of the importance of this region to mallard production and the increasing land use pressures, a focus on habitat restoration and management efforts in the SEC continues to be important.

Blue-winged Teal: After 2 years of the spring breeding survey being conducted while significant blue-winged teal migration was occurring through the state, the 2006 survey appeared to occur after the teal migration. As a result, the 2006 blue-winged teal breeding population estimate of 108,701 (+/- 22,993) is a substantial decrease from 2004 and 2005 but better represents the number of resident breeding blue-winged teal. The 2006 estimate is down 44% from 2005 ($Z=1.71$, $p=0.09$). This estimate is 4% below the long-term mean (33 year) calculated without the years of 1981, 2004 and 2005 because there were a high proportion of migrants in the survey those years (Tables 3, and 4; Figure 4). The 2006 estimate when compared to recent years (1997-2006) without high migrant numbers would suggest a good breeding year for blue-winged teal in Wisconsin.

Wood Ducks: In 2006, the population estimate for wood ducks is 121,650 (+/- 21,839) which is about average when compared to recent years (1997-2006). This estimate is 14% below 2005 ($Z=0.54$, $p=0.59$) and 70% above the long-term mean. Current trend analysis for wood ducks in Wisconsin suggests that the long term increase in the breeding population is leveling off. Between 1973 and 1997 the population estimate for wood ducks exceeded 100,000 only twice, however, since 1998 the population has varied between 110,109 and 141,882 (Table 3, Figure 5).

Other Ducks: The 2006 population estimate for the “other duck” group of 72,726 (+/-26,714) is up 3% from 2005 ($Z=0.06$, $p=0.95$) and 33% above the long-term mean. The species included in the other duck group in 2006 are green-winged teal, northern shoveler, ring-necked duck, hooded merganser and common merganser. Several duck species normally spotted in small breeding numbers were not observed in 2006 including; ruddy ducks, redheads, gadwall and black ducks.

Total Ducks: The total state breeding duck population estimate of 522,571 (+/- 51,502) is down 28% from 2005 ($Z=2.29$, $p=0.02$) and 22% above the long-term mean. (Table 3; Figure 6). When

compared with the average estimate of 565,585 from more recent years (1997-2006) the 2006 estimate is about or slightly below average. This 10 year average is somewhat inflated by the 2 years of high migrant blue-winged teal numbers.

Overall breeding duck survey results indicate a healthy, relatively stable population of breeding ducks in Wisconsin experiencing normal annual fluctuations. This is a positive indication of hunting regulations and habitat management/protection. The 2006 survey was somewhat later in relation to the progression of spring compared to recent years and was delayed by poor weather. Current landscape conditions seem to be supporting total breeding duck numbers at a level over 500,000 while mallard breeding numbers are stable at a level near 250,000. The lower than historic blue-winged teal breeding population numbers continue to be a concern and additional research on this species in Wisconsin is warranted. Wood ducks continue to be an encouraging contribution to the state's breeding waterfowl population at a level near 125,000. The actual 2006 production of ducks will depend, in part, on the impact of heavy May rain events. In some areas this likely improved brood habitat while in others, the May storms may have had negative impacts on nesting.

Canada Geese: Based on the most recent harvest derivations, the proportion of the Wisconsin Canada goose harvest that comes from giant Canada geese has increased to 49% with most of those birds representing Canada geese that breed in Wisconsin (T. Moser, 2005 USFWS memo). This increase indicates the continued importance of instate breeding Canada geese in our overall fall harvest. The statewide breeding Canada goose population estimate of 134,683 (+/- 20,923) is up 9% from 2005 and 83% above the long-term (20-year) mean. The 2005 estimate is within the expected annual variation that would be consistent with the long-term increasing trend in breeding giant Canada geese in Wisconsin.

It is important to remember that our spring survey was designed to count ducks and not geese, so we continue to believe that this survey underestimates the growing resident goose population. While giant Canada geese represent a positive resource for some Wisconsin residents they also represent a problem for other residents in cities and on farms where increased populations are causing conflicts. The early September Canada goose season should continue to be encouraged as a hunting opportunity and a population management tool because it targets giant Canada geese that breed in Wisconsin. We will need to continue to adapt harvest strategies, banding plans, nuisance goose programs, and survey

strategies if the breeding population of giant Canada geese increases and expands across Wisconsin. (Tables 3, and 4; Figure 7).

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Table 1. Wisconsin average precipitation from October 1, 2005- February 28, 2006, and March 1 - May 31, 2006.

	Oct. 1, 2005-February 28, 2006				March 1, 2006- May 31, 2006		
Division	Total	Departure from Normal*	Percent Change from Normal*		Total	Departure from Normal*	Percent Change from Normal*
	(inches)	(inches)			(inches)	(inches)	
1 (NW)	11.51	3.74	48.1%		7.11	-0.35	-4.7%
2 (NC)	11.13	2.64	31.1%		7.6	0.11	1.5%
3 (NE)	10.95	2.34	27.2%		8.77	0.85	10.7%
4 (WC)	6.15	-1.47	-19.3%		10.07	1.4	16.2%
5 (C)	7.54	-0.58	-7.1%		9.34	0.73	8.5%
6 (EC)	9.24	0.25	2.8%		10.74	2.89	36.8%
7 (SW)	6.41	-1.71	-21.1%		11.75	2.51	27.2%
8 (SC)	9.05	0.02	0.2%		12.25	3.18	35.1%
9 (SE)	9.34	-0.51	-5.2%		12.24	3.44	39.1%
Statewide Average	9.32	0.97	11.6%		9.42	1.23	15.0%

Prepared by Wisconsin State Climatology Office 12 June 2006

Table 2. Numbers of wetlands per square mile observed, 1973-2006.

Stratum and Wetland Type	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
<u>SEC</u>												
I,II,VI	5.8	3.0	3.4	3.7	1.0	2.8	5.6	1.7	4.5	1.8	3.3	7.8
III	1.2	0.8	1.1	1.3	0.7	0.6	0.9	0.8	1.1	1.1	0.8	0.6
IV,V	1.6	2.0	1.8	1.6	1.4	2.1	2.5	2.4	2.7	2.6	2.0	2.0
VII,VIII	0.8	0.5	0.8	1.1	0.3	0.8	2.0	0.9	1.3	1.5	0.8	1.4
Tot.Nonlin.	9.5	6.4	7.1	7.7	3.3	6.3	11.1	5.8	9.7	7.0	6.9	11.8
Stream	1.4	1.2	1.3	1.5	0.9	1.5	1.7	1.4	1.7	1.7	2.0	2.2
Ditch	1.0	1.5	1.9	1.7	1.4	2.2	2.5	2.2	2.9	2.5	2.8	4.1
Tot.Linear	2.4	2.7	3.1	3.2	2.3	3.7	4.2	3.6	4.6	4.2	4.8	6.3
<u>NHI</u>												
I,II,VI	1.1	1.3	2.6	2.4	0.9	3.6	4.3	1.4	4.9	3.4	4.2	5.5
III	0.7	0.8	0.9	0.7	0.8	0.6	0.6	0.8	0.7	1.8	0.7	1.0
IV,V	2.8	2.9	3.1	3.0	2.5	2.8	3.4	3.3	3.1	4.6	3.5	3.9
VII,VIII	0.7	0.5	0.7	0.8	0.3	2.1	4.6	1.3	3.2	2.0	1.3	3.4
Tot.Nonlin.	5.3	5.5	7.3	7.0	4.5	9.1	13.0	6.7	11.8	11.8	9.7	13.9
Stream	1.9	1.4	1.3	1.5	1.1	2.1	2.5	1.7	2.4	2.4	2.2	3.2
Ditch	0.1	0.1	0.2	0.2	0.1	0.4	0.3	0.2	0.4	0.5	0.5	0.8
Tot.Linear	2.0	1.5	1.5	1.6	1.2	2.5	2.8	1.9	2.7	2.9	2.7	3.9
<u>NLO</u>												
I,II,VI	2.1	1.0	1.0	1.6	0.5	2.1	3.5	0.9	3.9	1.8	2.3	5.7
III	0.7	0.5	0.6	0.4	0.4	0.5	0.4	0.6	0.5	1.0	0.3	0.5
IV,V	1.7	0.9	1.1	1.1	1.1	1.5	1.8	2.1	1.5	2.3	1.7	1.6
VII,VIII	1.0	0.5	0.7	0.8	0.1	2.0	4.6	1.1	3.0	3.7	1.5	2.8
Tot.Nonlin.	5.5	2.9	3.4	3.8	2.2	6.1	10.2	4.6	9.0	8.7	5.8	10.6
Stream	3.1	2.1	2.1	2.3	1.6	3.3	3.6	3.1	3.6	3.6	3.7	4.4
Ditch	0.3	0.4	0.4	0.4	0.2	0.6	0.6	0.4	0.5	0.5	0.6	1.1
Tot.Linear	3.3	2.5	2.5	2.7	1.8	3.9	4.2	3.5	4.2	4.1	4.3	5.5

* Wetland classification system from March et al. 1973.

Table 2 Continued.

Stratum and Wetland Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
<u>SEC</u>												
I,II,VI	3.5	3.7	4.3	2.4	3.8	2.7	6.1	6.9	10.5	4.6	4.4	4.9
III	0.9	0.6	1.2	0.8	1.2	1.1	1.1	1.2	1.5	1.9	1.3	1.0
IV,V	2.4	2.5	3.0	2.9	2.8	3.2	3.2	2.5	3.5	3.0	3.5	3.5
VII,VIII	1.1	1.1	0.7	0.9	1.4	1.1	2.2	1.3	2.0	1.1	0.8	1.5
Tot.Nonlin.	7.8	7.9	9.1	7.1	9.2	8.1	12.7	11.9	17.5	10.5	10.0	10.9
Stream	2.0	1.5	2.2	2.2	1.8	1.7	2.1	2.1	1.9	2.0	2.1	1.8
Ditch	3.9	2.6	2.7	2.4	3.3	2.3	3.5	2.8	3.2	2.8	2.7	2.5
Tot.Linear	5.9	4.0	4.9	4.7	5.1	4.0	5.6	4.9	5.1	4.8	4.8	4.3
<u>NHI</u>												
I,II,VI	3.2	9.1	3.4	2.9	4.0	3.4	8.2	6.8	5.7	2.9	3.3	2.8
III	1.1	0.4	1.4	1.2	2.2	1.3	1.8	0.7	1.3	2.5	2.8	1.2
IV,V	3.9	3.8	3.1	5.1	5.1	4.2	5.0	3.2	4.4	4.5	5.1	6.0
VII,VIII	1.6	2.9	1.6	2.1	4.3	3.4	5.8	1.8	1.7	1.1	2.1	3.6
Tot.Nonlin.	9.8	16.2	9.5	11.3	15.6	12.3	20.8	12.4	13.1	10.9	13.2	13.5
Stream	2.4	2.0	2.0	2.0	2.5	2.7	3.1	2.3	2.4	2.5	2.3	2.5
Ditch	0.4	0.6	0.5	0.4	0.8	0.5	1.0	0.4	0.3	0.4	0.6	0.4
Tot.Linear	2.8	2.6	2.5	2.4	3.3	3.3	4.1	2.7	2.7	2.9	2.8	3.0
<u>NLO</u>												
I,II,VI	2.8	6.1	4.0	3.8	6.5	4.0	9.7	4.1	10.6	3.8	5.0	3.0
III	0.4	0.3	0.7	0.5	1.1	0.6	0.9	0.7	0.9	1.6	1.5	0.2
IV,V	2.1	2.0	2.0	2.8	3.0	2.7	3.0	1.9	2.8	2.5	3.1	2.3
VII,VIII	1.3	2.3	1.1	2.6	2.8	3.0	5.9	1.6	2.5	1.3	1.4	2.5
Tot.Nonlin.	6.5	10.7	7.8	9.6	13.5	10.3	19.6	8.3	16.8	9.3	11.0	8.0
Stream	3.4	3.0	2.9	2.9	3.4	4.1	3.9	3.6	3.2	3.6	3.8	3.2
Ditch	0.8	0.6	0.5	0.7	1.0	0.9	1.7	0.8	0.9	1.0	1.0	0.8
Tot.Linear	4.2	3.6	3.3	3.6	4.4	5.0	5.5	4.4	4.1	4.6	4.7	4.0

Table 2. Continued

Stratum and Wetland Type	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1973- 05 mean	% Change from 2005	% Change from 1973-05 mean	10 year mean (1997- 2006)
<u>SEC</u>														
I,II, VI	6.6	3.5	3.5	1.6	3.2	4.9	1.9	1.9	1.1	2.5	4.0	121.5	-37.0	3.1
III	1.5	0.8	0.8	0.1	1.0	0.6	0.3	0.8	0.4	0.4	1.0	-6.2	-56.9	0.7
IV, V	3.9	3.1	3.6	3.5	3.4	3.9	3.5	3.2	3.6	3.6	2.8	1.3	27.8	3.5
VII, VIII	0.9	0.9	0.8	0.6	0.8	1.0	0.6	1.1	1.1	1.2	1.1	8.7	10.7	0.9
Tot.	12.9	8.4	8.6	5.8	8.4	10.4	6.4	7.0	6.2	7.7	8.9	23.9	-12.7	8.2
Nonlin.														
Stream	1.9	1.8	1.8	1.6	1.7	1.7	1.6	1.8	1.8	1.8	1.7	0.8	5.7	1.8
Ditch	3.1	2.5	1.3	1.5	2.0	2.4	1.8	2.4	2.1	2.2	2.4	2.9	-11.8	2.1
Tot.	5.0	4.2	3.0	3.1	3.7	4.1	3.4	4.2	3.9	4.0	4.2	1.9	-4.5	3.9
Linear														
<u>NHI</u>														
I,II, VI	3.7	2.4	4.2	2.4	6.2	4.4	2.4	1.6	1.0	2.6	3.7	148.0	-29.8	3.1
III	2.6	1.3	1.7	1.5	2.8	2.0	1.2	1.6	0.7	1.2	1.3	62.0	-11.5	1.7
IV, V	3.7	3.6	4.0	4.5	3.7	4.9	5.0	4.2	4.3	4.9	4.0	15.6	23.7	4.3
VII, VIII	2.2	2.6	2.0	2.6	4.1	3.9	2.5	2.5	1.6	1.6	2.4	-0.6	-32.5	2.6
Tot.	12.2	9.9	11.9	11.0	16.8	15.1	11.0	9.8	7.7	10.3	11.4	34.7	-9.5	11.6
Nonlin.														
Stream	2.2	2.0	2.3	2.4	2.5	2.1	2.2	2.7	2.1	2.6	2.2	22.4	16.1	2.3
Ditch	0.4	0.2	0.6	0.3	0.5	0.4	0.3	0.2	0.3	0.7	0.4	131.0	73.1	0.4
Tot.	2.6	2.2	2.8	2.6	2.9	2.5	2.6	2.9	2.4	3.3	2.6	35.9	24.8	2.7
Linear														

Table 2. Continued

Stratum and Wetland Type	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1973- 05 mean	% Change from 2005	% Change from 1973-05 mean	10 year mean (1997- 2006)
<u>NLO</u>														
I,II, VI	10.6	2.9	5.2	4.4	6.9	6.2	3.8	2.3	2.7	6.4	4.2	135.5	52.8	5.1
III	1.6	0.7	1.3	1.3	1.3	1.5	0.8	1.3	0.5	0.8	0.8	68.9	-3.3	1.1
IV, V	3.1	2.1	2.2	2.1	2.1	3.0	2.6	2.3	2.8	2.9	2.2	3.6	35.8	2.5
VII, VIII	3.3	1.5	1.7	2.8	3.2	3.7	2.8	2.5	1.5	1.7	2.3	15.3	-24.9	2.5
Tot.	18.6	7.1	10.5	10.7	13.5	14.4	10.0	8.4	7.5	11.8	9.4	57.7	25.4	11.3
Nonlin. Stream	3.5	3.6	3.9	3.5	3.4	2.9	3.0	4.1	3.6	3.9	3.3	9.1	17.8	3.5
Ditch	1.4	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.8	1.2	0.7	53.3	66.7	0.8
Tot. Linear	4.9	4.3	4.4	4.1	4.0	3.6	3.7	4.8	4.4	5.1	4.0	16.9	26.4	4.3
<u>SWD</u>														
I,II, VI	2.3	0.7	2.0	1.2	1.2	1.7	0.6	0.7	0.8	0.9	1.4	13.6	-32.7	1.2
III	0.5	0.4	0.4	0.2	0.2	0.2	0.3	0.1	0.3	0.3	0.3	4.5	-14.1	0.3
IV, V	2.0	1.2	1.8	1.4	1.4	2.0	1.2	1.3	1.9	1.7	1.6	-13.1	5.9	1.6
VII, VIII	0.4	0.0	0.1	0.1	0.1	0.3	0.1	0.1	0.3	0.2	0.2	-36.0	3.6	0.2
Tot.	5.1	2.3	4.2	2.9	2.9	4.2	2.2	2.2	3.3	3.1	3.5	-7.3	-11.2	3.2
Nonlin. Stream	3.7	2.9	4.0	3.4	3.4	2.7	2.7	2.7	3.4	2.7	3.1	-19.1	-12.4	3.2
Ditch	0.8	0.3	0.7	0.4	0.4	0.3	0.4	0.4	0.4	0.5	0.5	13.5	0.0	0.5
Tot. Linear	4.5	3.2	4.7	3.8	3.8	3.0	3.1	3.1	3.8	3.2	3.6	-15.3	-10.6	3.6

¹ Years used to determine SWD mean are 1997-2005.

Table 3. Breeding waterfowl population estimates in Wisconsin, 1973-2006.

Stratum and Year	Mallard	Blue-Winged Teal	Wood Ducks	Other Ducks	Total Ducks	Canada Geese ¹
Southwest						
1973	10910	15014	1022	1251	28197	
1974	9621	20610	2378	781	33390	
1975	12287	19231	4084	467	36069	
1976	11206	16253	4029	471	31959	
1977	9349	15855	3307	159	28670	
1978	6288	10871	2743	635	20537	
1979	8017	9792	4881	380	23070	
1980	11882	5622	4506	362	22372	
1981	14569	20902	6286	697	42454	
1982	9126	7990	1467	232	18815	
1983	12185	4898	1639	129	18851	
1984	10685	5261	4357	132	20435	
1985	7539	6820	3967	98	18424	
1986	11298	4153	12743	190	28384	913
1987	13969	10046	15146	336	39497	1191
1988	15188	5474	8356	180	29198	1258
1989	18429	10130	9190	1068	38817	4349
1990	15438	5684	10328	440	31890	1873
1991	17587	5429	10680	1397	35093	1962
1992	25472	14509	22348	1208	63537	2843
1993	17802	8008	11375	353	37538	2820
1994	28907	11667	9714	888	51176	2962
1995	24701	9554	23663	865	58783	4858
1996	32070	5667	11777	830	50344	4583
1997	23945	11823	7473	0	43241	3338
1998	10469	0	13842	0	24311	3727
1999	21126	10651	28838	0	60615	10173
2000	55096	3976	16192	0	75264	12159
2001	19884	3351	18456	0	41691	9546
2002	41329	9059	39858	0	90246	10147
2003	30659	17637	10597	1122	60015	21841
2004	24301	12445	18205	6855	61806	13403
2005	44242	0	16633	0	60875	8177
2006	27154	11929	16529	0	55612	17193

MEAN (73-05):	18956.8	9501.2	10911.5	652.3	40168.6	6106.2		
Stratum and Year	Mallard	Blue-Winged Teal²	Wood Ducks	Other Ducks	Total Ducks	Canada Geese¹		
Southwest								
1973	10,910	15,014	1,022	1,251	28,197			
1974	9,621	20,610	2,378	781	33,390			
1975	12,287	19,231	4,084	467	36,069			
1976	11,206	16,253	4,029	471	31,959			
1977	9,349	15,855	3,307	159	28,670			
1978	6,288	10,871	2,743	635	20,537			
1979	8,017	9,792	4,881	380	23,070			
1980	11,882	5,622	4,506	362	22,372			
1981	14,569	20,902	6,286	697	42,454			
1982	9,126	7,990	1,467	232	18,815			
1983	12,185	4,898	1,639	129	18,851			
1984	10,685	5,261	4,357	132	20,435			
1985	7,539	6,820	3,967	98	18,424			
1986	11,298	4,153	12,743	190	28,384	913		
1987	13,969	10,046	15,146	336	39,497	1,191		
1988	15,188	5,474	8,356	180	29,198	1,258		
1989	18,429	10,130	9,190	1,068	38,817	4,349		
1990	15,438	5,684	10,328	440	31,890	1,873		
1991	17,587	5,429	10,680	1,397	35,093	1,962		
1992	25,472	14,509	22,348	1,208	63,537	2,843		
1993	17,802	8,008	11,375	353	37,538	2,820		
1994	28,907	11,667	9,714	888	51,176	2,962		
1995	24,701	9,554	23,663	865	58,783	4,858		
1996	32,070	5,667	11,777	830	50,344	4,583		
1997	23,945	11,823	7,473	0	43,241	3,338		
1998	10,469	0	13,842	0	24,311	3,727		
1999	21,126	10,651	28,838	0	60,615	10,173		
2000	55,096	3,976	16,192	0	75,264	12,159		
2001	19,884	3,351	18,456	0	41,691	9,546		
2002	41,329	9,059	39,858	0	90,246	10,147		
2003	30,659	17,637	10,597	1,122	60,015	21,841		
2004	24,301	12,445	18,205	6,855	61,806	13,403		
2005	44,242	0	16,633	0	60,875	8,177		
2006	27,154	11,929	16,529	0	55,612	17,193		

MEAN (73-05):	18,956.8	9,501.2	10,911.5	652.3	40,168.6	6,106.2
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Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal ²	Wood Ducks	Other Ducks	Total Ducks	Canada Geese ¹
Southeast Central						
1973	56,632	147,748	807	105,245	310,432	
1974	61,042	217,734	4,841	65,024	348,641	
1975	67,247	193,932	11,297	36,199	308,675	
1976	58,814	152,089	9,683	29,831	250,417	
1977	41,816	126,116	15,331	9,385	192,648	
1978	30,977	75,132	9,683	42,232	158,024	
1979	35,125	71,549	12,104	19,440	138,218	
1980	44,175	34,425	10,490	14,748	103,838	
1981	65,784	131,567	12,910	40,891	251,152	
1982	45,758	66,732	6,455	18,099	137,044	
1983	56,863	48,414	6,455	6,033	117,765	
1984	43,240	45,589	8,069	5,028	101,926	
1985	38,906	43,985	12,910	4,357	100,158	
1986	53,938	26,360	34,697	3,352	118,347	7,640
1987	66,657	75,001	20,771	16,759	179,188	9,277
1988	53,091	29,033	8,851	4,357	95,332	9,095
1989	63,795	60,409	27,799	25,808	177,811	39,109
1990	57,853	34,980	21,307	6,033	120,173	12,551
1991	69,114	36,814	24,009	34,523	164,460	16,917
1992	115,344	116,706	61,856	66,604	360,510	26,921
1993	90,471	62,642	33,271	9,152	195,536	21,101
1994	174,488	103,386	32,805	36,500	347,179	27,649
1995	137,757	90,305	80,564	28,223	336,849	45,475
1996	152,951	56,096	31,393	27,077	267,517	39,377
1997	90,397	48,711	66,816	5,952	211,876	56,116
1998	105,733	49,757	49,758	7,843	213,091	54,172
1999	110,406	57,220	45,931	8,975	222,532	54,502
2000	207,191	71,240	64,061	7,853	350,345	83,314
2001	83,621	35,675	51,034	3,875	174,205	56,241
2002	193,365	40,077	50,284	28,069	311,795	79,264
2003	140,726	28,042	48,643	39,703	257,114	165,303
2004	124,980	162,121	61,526	17,691	366,318	103,119
2005	158,797	151,774	50,286	27,371	388,228	82,849
2006	115,872	60,473	39,612	8,234	224,191	72,393
MEAN (73-05):	87,789.5	74,863.3	29,899.9	24,310.1	223,555.9	49,499.6

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal ²	Wood Ducks	Other Ducks	Total Ducks	Canada Geese ¹
Northern High						
1973	13,602	9,594	0	3,929	27,125	
1974	13,058	9,594	6,621	1,179	30,452	
1975	26,376	19,346	4,729	3,143	53,594	
1976	25,645	18,331	2,837	5,893	52,706	
1977	19,138	29,483	2,837	3,536	54,994	
1978	13,640	31,958	3,783	5,500	54,881	
1979	20,942	21,412	1,892	11,393	55,639	
1980	37,872	19,852	9,458	9,822	77,004	
1981	34,822	43,776	10,404	5,107	94,109	
1982	20,355	15,781	0	2,750	38,886	
1983	27,950	3,547	946	1,571	34,014	
1984	22,730	7,634	9,458	5,500	45,322	
1985	15,391	23,795	5,675	3,143	48,004	
1986	23,876	11,235	16,078	9,036	60,225	1,492
1987	32,271	15,552	36,032	9,429	93,284	4,051
1988	46,752	18,994	26,800	3,143	95,689	4,264
1989	47,015	31,428	7,965	52,251	138,659	5,970
1990	42,916	15,033	29,238	14,929	102,116	6,610
1991	41,472	9,530	13,727	55,787	120,516	4,691
1992	52,293	14,450	22,608	28,315	117,666	4,904
1993	32,308	9,607	6,658	10,727	59,300	9,381
1994	48,830	13,058	4,272	18,691	84,851	2,985
1995	43,596	4,975	35,910	31,825	116,306	7,462
1996	50,294	1,566	13,957	30,533	96,350	8,528
1997	27,716	7,664	17,762	15,115	68,257	14,713
1998	36,194	18,417	40,377	11,031	106,019	8,627
1999	60,939	9,863	23,927	13,353	108,082	21,844
2000	89,946	29,896	45,214	20,502	185,558	25,567
2001	44,191	21,722	46,359	21,349	133,621	16,183
2002	69,938	12,918	25,836	83,469	192,161	16,992
2003	40,188	5,716	20,608	13,815	80,327	35,596
2004	42,530	17,927	17,046	48,137	125,640	25,554
2005	56,253	19,471	47,440	12,222	135,386	17,415
2006	40,198	23,198	39,287	38,603	141,286	25,221
MEAN (73-05):	37,001.2	15,398.4	16,862.2	17,155.3	87,477.1	12,141.5

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal ²	Wood Ducks	Other Ducks	Total Ducks	Canada Geese ¹
Northern Low						
1973	25,812	13,005	4,807	3,328	46,952	
1974	10,601	6,502	1,602	3,994	22,699	
1975	14,550	4,917	6,410	2,663	28,540	
1976	14,197	13,976	9,615	6,656	44,444	
1977	21,354	24,283	0	1,331	46,968	
1978	10,741	16,244	1,602	9,319	37,906	
1979	14,516	18,139	12,820	3,328	48,803	
1980	22,559	9,505	4,807	7,988	44,859	
1981	27,656	61,809	11,217	16,641	117,323	
1982	14,233	8,138	1,602	0	23,973	
1983	22,464	3,606	1,602	3,994	31,666	
1984	28,104	6,467	6,410	1,331	42,312	
1985	12,073	9,599	3,205	1,331	26,208	
1986	21,651	9,518	19,229	4,659	55,057	1,084
1987	24,050	23,422	26,400	3,994	77,866	0
1988	33,870	14,079	10,253	8,653	66,855	722
1989	51,437	23,095	14,722	17,972	107,226	3,612
1990	35,149	14,472	6,192	18,638	74,451	1,806
1991	44,250	15,250	20,933	35,279	115,712	361
1992	56,618	33,460	38,306	13,707	142,091	0
1993	33,950	18,602	22,562	11,883	86,997	1,084
1994	31,175	15,930	16,287	24,631	88,023	2,529
1995	36,112	13,111	13,521	17,737	80,481	1,445
1996	79,098	6,631	19,348	17,017	122,094	3,400
1997	38,910	2,597	27,359	17,073	85,939	4,399
1998	34,495	7,801	17,736	9,345	69,377	8,186
1999	55,975	6,684	15,202	7,541	85,402	14,664
2000	101,746	12,226	16,415	2,836	133,223	8,468
2001	35,757	16,562	15,202	23,088	90,609	12,096
2002	73,910	3,979	19,151	49,549	146,589	12,073
2003	49,759	38,741	30,261	17,248	136,009	19,190
2004	37,364	21,262	17,773	21,331	97,730	6,927
2005	57,933	23,993	26,793	31,061	139,780	15,395
2006	36,270	13,101	26,222	25,889	101,482	19,876
MEAN (73-05):	35,517.2	13,684.7	13,919.5	12,580.2	77,701.9	5,872.1

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal ²	Wood Ducks	Other Ducks	Total Ducks	Canada Geese ¹
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All Stratum						
1973	106,956	185,361	6,636	113,753	412,706	
1974	94,322	254,440	15,442	70,978	435,182	
1975	120,460	237,426	26,520	42,472	426,878	
1976	109,862	200,649	26,164	42,851	379,526	
1977	91,657	195,737	21,475	14,411	323,280	
1978	61,646	134,205	17,811	57,686	271,348	
1979	78,600	120,892	31,697	34,541	265,730	
1980	116,488	69,404	29,261	32,920	248,073	
1981	142,831	258,054	40,817	63,336	505,038	
1982	89,472	98,641	9,524	21,081	218,718	
1983	119,462	60,465	10,642	11,727	202,296	
1984	104,759	64,951	28,294	11,991	209,995	
1985	73,909	84,199	25,757	8,929	192,794	
1986	110,763	51,266	82,747	17,237	262,013	11,129
1987	136,947	124,021	98,349	30,518	389,835	14,519
1988	148,901	67,580	54,260	16,333	287,074	15,339
1989	180,676	125,062	59,676	97,099	462,513	53,040
1990	151,356	70,169	67,065	40,040	328,630	22,840
1991	172,423	67,023	69,349	126,986	435,781	23,931
1992	249,727	179,125	145,118	109,834	683,804	34,668
1993	174,531	98,859	73,866	32,115	379,371	34,386
1994	283,400	144,041	63,078	80,710	571,229	36,125
1995	242,166	117,945	153,658	78,650	592,419	59,240
1996	314,413	69,960	76,475	75,457	536,305	55,888
1997	180,968	70,795	119,410	38,140	409,313	78,566
1998	186,891	75,975	121,713	28,219	412,798	74,712
1999	248,446	84,418	113,898	29,869	476,631	101,183
2000	453,979	117,338	141,882	31,191	744,390	129,508
2001	183,453	77,310	131,051	48,312	440,126	94,066
2002	378,542	66,033	135,129	161,087	740,791	118,476
2003	261,332	90,136	110,109	71,888	533,465	241,930
2004	229,175	213,755	114,550	94,014	651,494	149,003
2005	317,224	195,239	141,152	70,655	724,270	123,836
2006	219,494	108,701	121,650	72,726	522,571	134,683
Change from 2005	-31%	-44%	-14%	3%	-28%	9%
MEAN (73-05):	179,264.8	113,447.5	71,593.2	54,697.9	428,903.5	73,619.3
MEAN (97-06):	265,950.4	86,338.3	125,054.4	64,610.1	565,584.9	124,596.3
Change from 73-05 Mean	22%	-4%	70%	33%	22%	83%

1 Prior to 1986, Canada goose numbers were too insignificant to include in the survey.

2 Long Term and 10-year means for Blue-winged Teal excludes migrant years (1981, 2004 and 2005)

Table 4. 2006 Wisconsin breeding waterfowl data.

Species	Area of stratum (mi ²)	Bird density seen from the air (birds/mi ²)	Aerial visibility correction factor ¹	Population estimate	Standard error of the population estimate	<u>Test for differences from 2005</u>	
						Z-statistic	Probability for type 1 error
Mallard							
Stratum ²							
SEC	17,949	2.625	2.459	115,872	25,014.3		
NHI	9,431	1.733	2.459	40,198	11,393.3		
NLO	15,979	0.923	2.459	36,270	11,096.6		
SWD	12,311	0.897	2.459	27,154	7,382.1		
Subtotal	55,670			219,494	30,547.5	1.85	=0.06
Blue-winged teal							
Stratum							
SEC	17,949	0.253	13.324	60,473	18,456.5		
NHI	9,431	0.185	13.324	23,198	9,703.9		
NLO	15,979	0.062	13.324	13,101	7,222.3		
SWD	12,311	0.073	13.324	11,929	6,459.2		
Subtotal	55,670			108,701	22,993.2	1.71	=0.09
Wood duck							
Stratum							
SEC	17,949	0.359	6.154	39,612	11,596.4		
NHI	9,431	0.677	6.154	39,287	12,695.6		
NLO	15,979	0.267	6.154	26,222	11,682.5		
SWD	12,311	0.218	6.154	16,529	6,695.0		
Subtotal	55,670			121,650	21,839.4	0.54	=0.59

Table 4. Continued

						<u>Test for differences from 2005</u>	
Species	Area of stratum (mi ²)	Bird density seen from the air (birds/mi ²)	Aerial visibility correction factor ¹	Population estimate	Standard error of the population estimate	Z-statistic	Probability for type 1 error
Other duck species³							
Stratum							
SEC	17,949	0.055	8.314	8,234	5,909.0		
NHI	9,431	0.492	8.314	38,603	18,589.1		
NLO	15,979	0.195	8.314	25,889	18,252.6		
SWD	12,311	0.0	0.0	0	0		
Subtotal	55,670			72,726	26,713.8	0.06	=0.95
Canada Geese							
Stratum							
SEC	17,949	1.995	2.021	72,393	16,128.0		
NHI	9,431	1.323	2.021	25,221	8,481.7		
NLO	15,979	0.615	2.021	19,876	8,295.7		
SWD	12,311	0.691	2.021	17,193	6,075.3		
Subtotal	55,670			134,683	20,923.2	0.37	=0.71

¹ Aerial Visibility Correction Factor (R) = number of birds seen from the ground divided by the number seen from the air on air-ground segments; The Coefficient of Variation (CV) of R was not precise enough (i.e., CV[R] > 20%) to use for individual species-strata in 2006. When air-ground data from all strata were pooled by species in 2006 the R was still not precise enough for any species-group except for Mallards (CV=20%). Air-ground data from past years were iteratively added in to achieve the desired precision. This was achieved for BWT, Wood Ducks, other ducks, and geese by using 5, 6, 12 and 2 years of air-ground data, respectively; this is similar to last year's precision.

² SEC = Southeast Central, NHI = Northern High, NLO = Northern Low, SWD = Southwest Driftless Strata.

³ As in other years, Lesser Scaup, Buffleheads, and all non-duck/goose waterbirds were excluded in the summaries. The duck species included in the "other ducks" were: SEC – Green-winged Teal, Northern Shoveler, Ring-necked Duck, Hooded Merganser; NHI – Northern Shoveler, Ring-necked Duck, Common Merganser, Hooded Merganser; NLO – Green-winged Teal, Hooded Merganser, Ring-necked Duck; SWD – none.

Figure 1. Transect Lines and Regions Surveyed

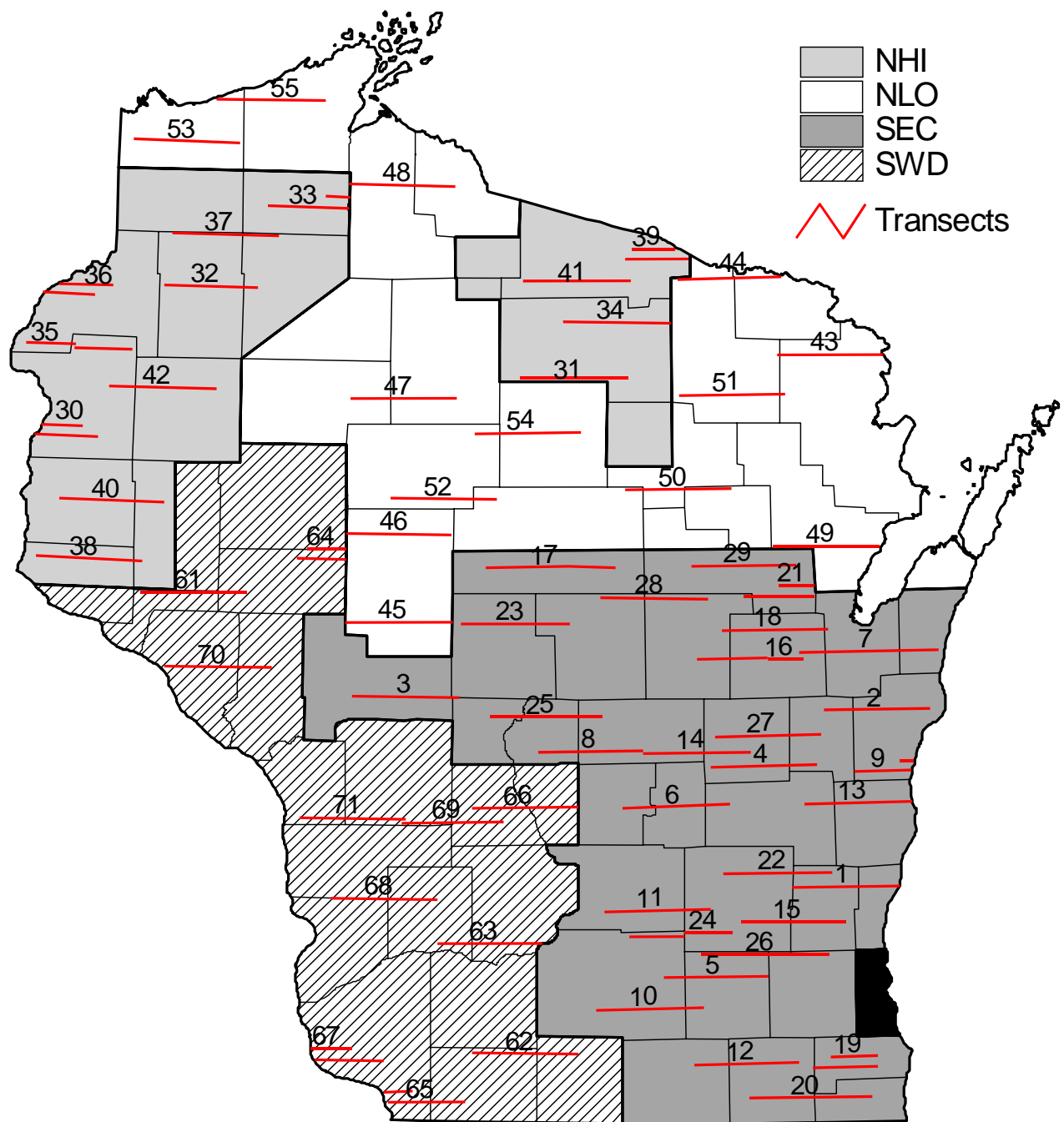


Figure 2. Climatology Divisions



Figure 3.

Wisconsin Breeding Mallard Population Estimates, 1973-2006

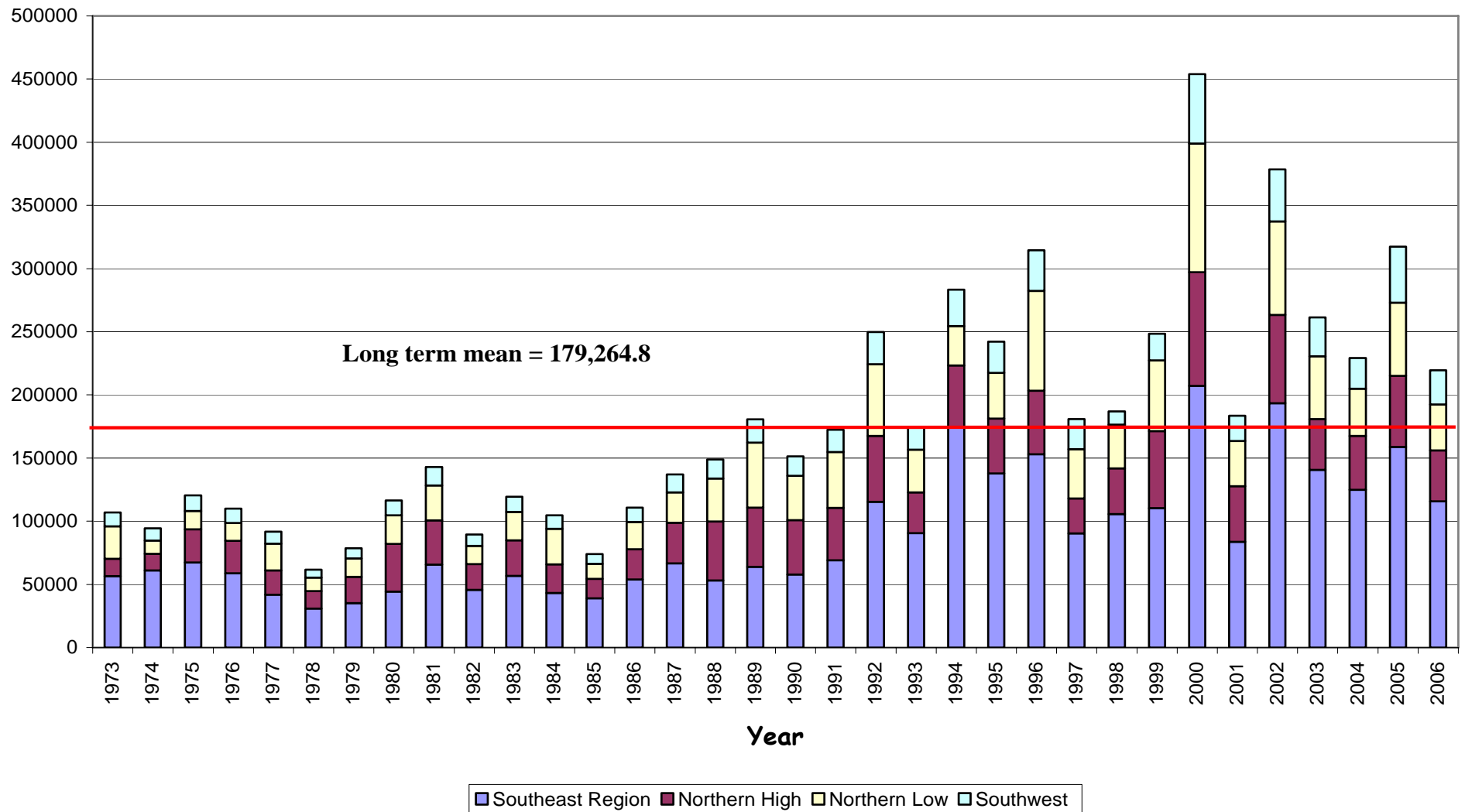


Figure 4.

**Wisconsin Breeding Blue-winged Teal Population Estimates,
1973-2006**

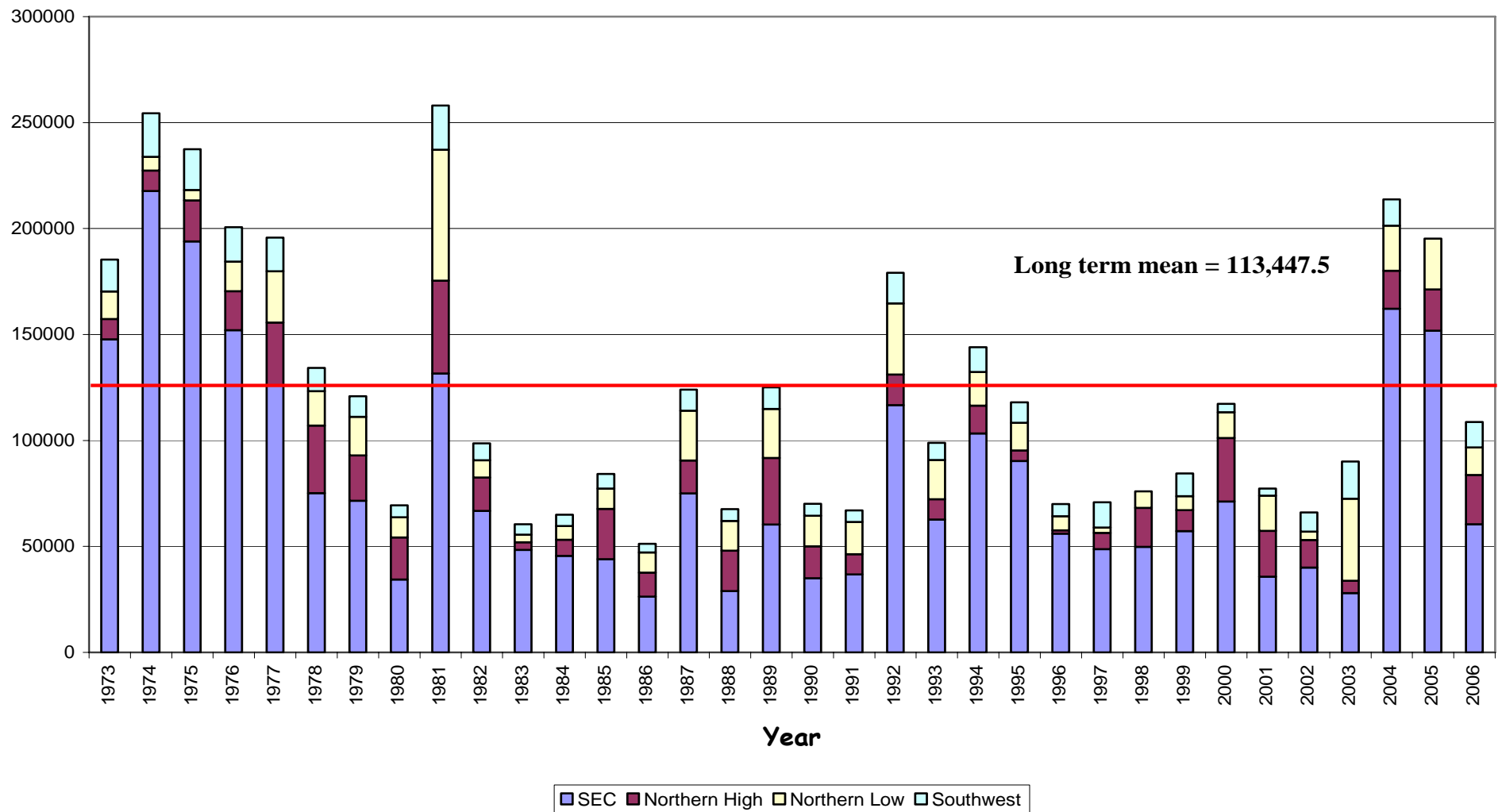


Figure 5.

Wisconsin Breeding Wood Duck Population Estimates,
1973-2006

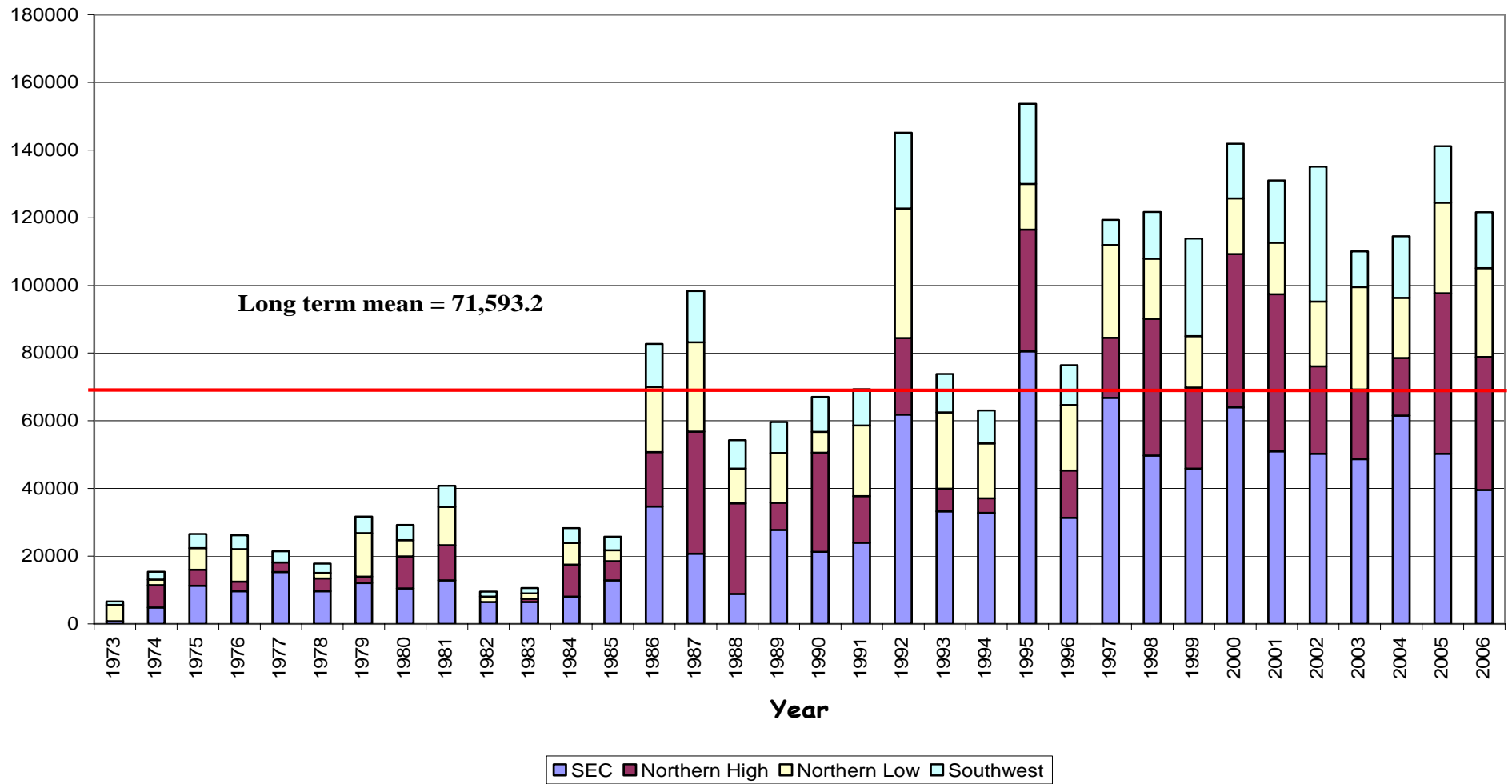


Figure 6.

**Wisconsin Total Breeding Duck Population Estimates,
1973-2006**

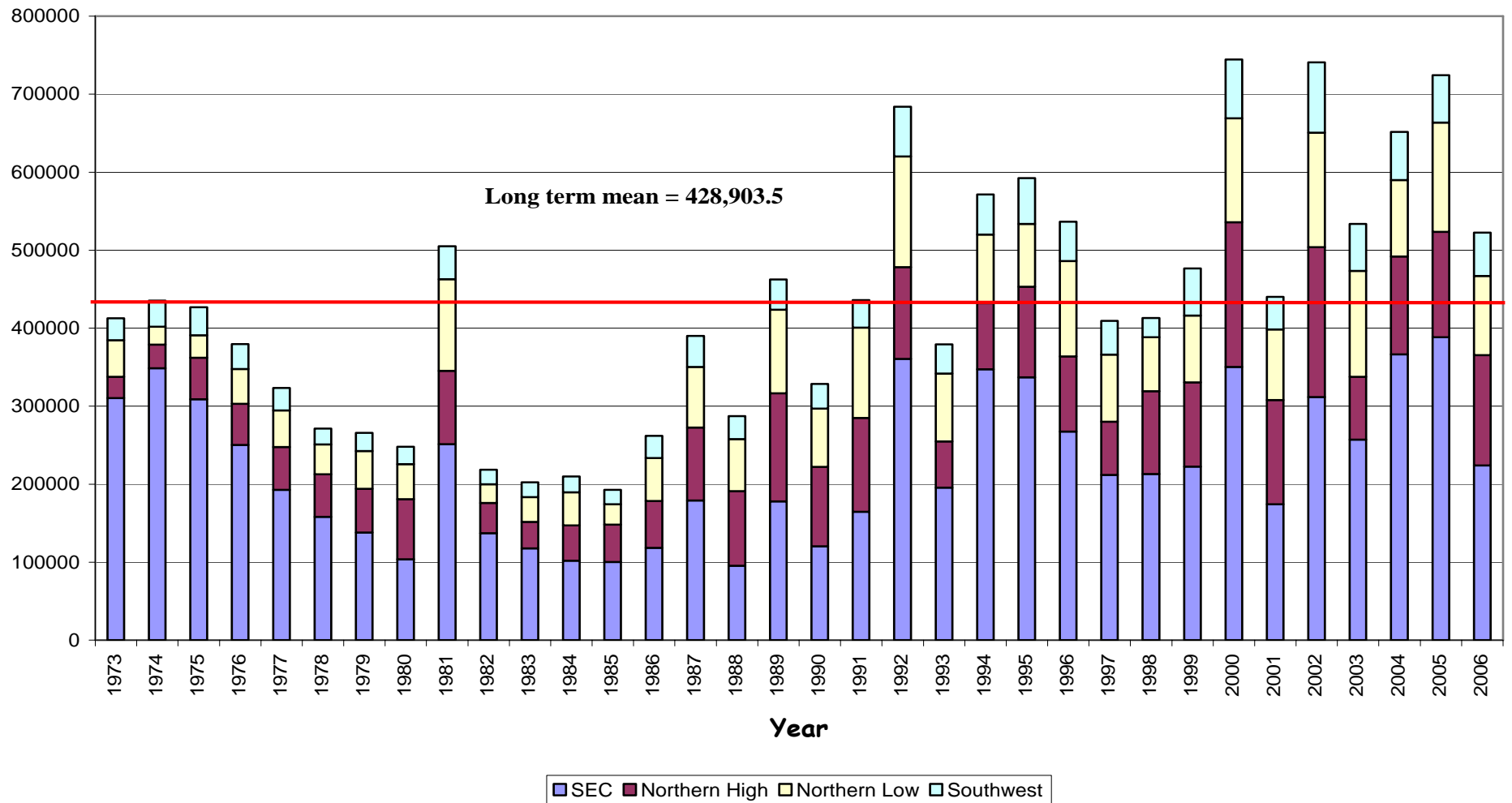
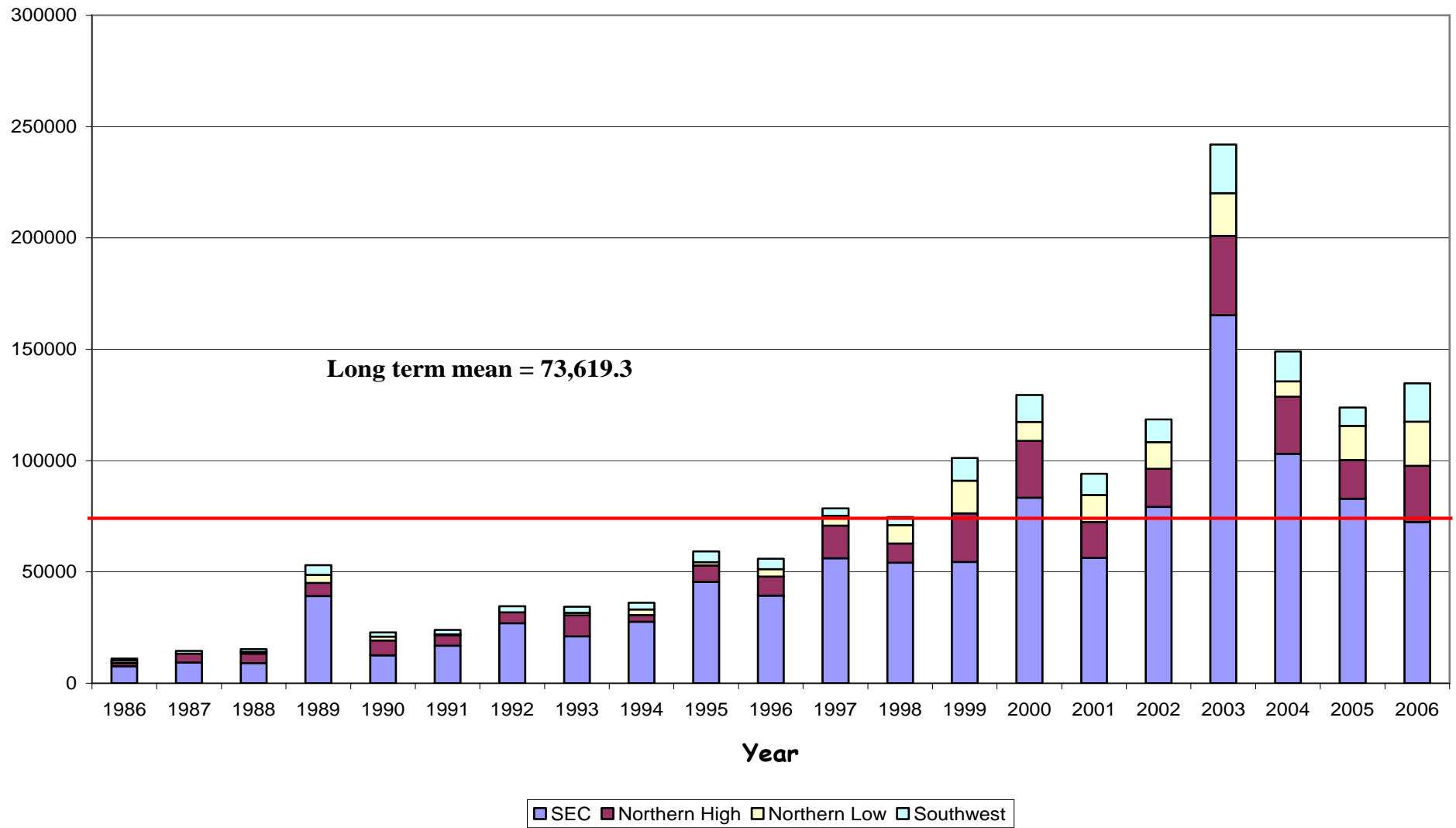


Figure 7

Wisconsin Canada Goose Breeding Population Estimates, 1986 - 2006



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WM-432